

Application No.: 10/664,247

Reply to Office Action of March 25, 2008

Docket No.: F118B

Remarks/Arguments:

Claims 1-25 are in the application. Claims 1, 4, 9, 10, 13 and 19 are in independent form.

Claim Rejections— 35 USC § 102

Claim 1 stands rejected under 35 USC §102(e) as being anticipated by Lowrey et al. (US 5,208,125). A claim is anticipated only if each and every element (limitation) as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *See* MPEP § 2131. Applicants submit that the reference cited by the Examiner does not set forth, either expressly or inherently, all of the elements of the rejected claim.

Claim 1 defines a defect area, stating: "the defect being an absence of opaque material on an area that should be covered by an opaque material." Claim 1 then requires "scanning a beam of metallic ions over the defect area to implant metallic atoms into the defect area, the metal atoms reducing the transparency of the defect area without depositing an opaque material to cover the defect area." (emphasis added).

Lowery does not contemplate repairing a defect area, or an area "that should be covered by an opaque material," (e.g., chrome on quartz) but instead teaches fabricating the entire photolithographic pattern "from scratch" by ion implantation. Particularly, he does not aim to implant ions to repair a defect in a pattern already formed (typically in a "lift-off" or photolithography process) of another material (chromium is the typical opaque material in photolithography patterns). Lowery explicitly states that "[p]roblems with this 'lift-off' process are that it is defect prone, inconsistent, a less manufacturable procedure and, thus, not as suitable for large scale manufacturing." Col. 3, lines 16-19. To remedy this "defect-prone" process, Lowery instead teaches fabricating the entire photolithographic pattern from scratch by ion implantation.

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"The method of the invention for forming phase shifting reticle in general, includes the steps of: forming a pattern of ion implant areas on a transparent quartz substrate in order to change the absorption characteristics of the quartz substrate to form opaque or light blocking areas." Col. 4, lines 43-48. The Examiner relies on claims 9+ of Lowery in particular to show anticipation of this claim. Lowery's claim 1 (from which claim 9 depends) recites: "A method of forming a phase shifting reticle comprising : forming a pattern of ion implant areas on a transparent substrate by ion bombardment of the substrate...; forming a second pattern of ion implant areas," and independent claim 11 (from which all subsequent claims depend) recites nearly the identical elements. It is clear that Lowery claims and teaches fabricating a reticle pattern entirely by ion bombardment by implanting ions into the substrate, and does not teach repairing a reticle which was made by a "lift off" or other process which therefore contains opaque material (typically chromium) deposited on top of the substrate. Lowery labels reticles made by such a lift-off process as "prior art" in FIGs. 1-5A.

Further, Lowery bombards the substrate with ions such as nitrogen, tungsten or chrome to form an opaque region. Col. 5, lines 57-63. Applicants' claim 1 teaches, instead, to "implant metallic ions into the defect area [to reduce] the transparency of the defect area without depositing an opaque material..." Applicants teach that "gallium implanted during scanning, at certain doses, is sufficient to reduce transmission or reflectivity, akin to material depositions." Para. [19].

Therefore, with the reference of Lowery expressly and inherently deficient of the limitations of claim 1, Lowery cannot anticipate claim 1. Applicants respectfully request reconsideration and allowance of this claim.

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Claim Rejections-- 35 USC § 103

Claims 2-4, 7-10, 13-15 and 19-20 stand rejected under 35 USC §103(a) as being unpatentable over Lowrey in view of Asano et al. (US 6,335,129), and additionally in view of Neary et al. (US 6,016,357). To establish a prima facie case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See* MPEP § 2143.01. The Examiner must further articulate some reason or rationale to combine the references as suggested. Applicants submit that the rejected claims all contain limitations which are not described or taught by the cited references. Further, the Examiner has failed to provide any rationale supporting the combination of references.

Claims 2 and 3

Claim 2 depends from claim 1 and includes all the limitations of claim 1. Claim 2 therefore requires "scanning a beam of metallic ions over the defect area to implant metallic atoms into the defect area," and further requires that the defect area be "an absence of opaque material on an area that should be covered by an opaque material." *See* Applicants' claim 1 (emphasis added).

As discussed above with respect to claim 1, Lowery is deficient in at least these limitations.

Neither does the Asano reference teach these limitations. Asano teaches repairing defects having an *excess* of material by "focusing the ion beam...to remove a part of the defect pattern film material ...the defect pattern film material being an opaque material different from a transparent material of the mask substrate." *See* Asano, claim 1. Therefore, Asano does not teach repairing defects of an absence of material by adding material to the defect area, or "scanning a beam of metallic ions over the defect area to implant metallic atoms into the defect area" as required by the

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claim of Applicants'. Further, Asano teaches that prior methods of repairing excess material defects can actually remove desired pattern material. In other words, removed pattern material is an unwanted side-effect of known excess material defect repair methods (see FIG 2A). And Asano does not contemplate repairing such side effects or missing-material defects, but rather teaches avoiding such defects entirely by using his method.

The Neary reference also does not teach limitations of claim 2 inherited from claim 1, particularly the limitation of "scanning a beam of metallic ions over the defect area to implant metallic atoms into the defect area." Neary describes analyzing an aerial image of a mask to ascertain the defect in the mask. Col. 2, lines 22-41. Neary then repairs the mask by applying a "repair patch" to the defect area. Col. 4, lines 33-52 and FIG. 4. However, Neary does not contemplate the use of a beam of metallic ions to create the repair patch. In fact, it appears that the repair patch is fabricated at a different location and then attached to the defect area of the mask, in contrast to the teaching of Applicants' claims of "scanning a beam of metallic ions over the defect area." Neary states: "The controller 12 then provides instruction to the mask repair tool 14 to apply the required patch to repair the mask defect." Col. 4, lines 13-15 (emphasis added). Neary is very ambiguous in this aspect and does not clearly state the method and material used to create and

apply the patch. Neary states that "[r]epair patch 28 is selected to add material of predetermined transmission level, phase shift, thickness, geometry and overlap to fully patch and repair the defect in accordance with well-known methods," (col. 4, lines 38-42, emphasis added) but does not describe the well-known methods, nor which materials may be selected for use in those methods. Instead, Neary falls back on the knowledge of others at the time of the invention for those methods and materials when he further states that "the controller is able to identify material deposition or

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ablation process parameters for the mask repair tool for each material property parameter desired in a look-up table in the database created in the system memory" further failing to disclose anywhere in the specification from which group of materials a material may be selected, or the database or look-up table the controller is to have access to.

Among the limitations inherited from claim 1, claim 2 also requires:

"scanning a beam of metallic ions over a non-defective area of the transparent substrate near the defect to implant metallic atoms in the non-defective area, the implantation of the metallic atoms in the non-defective area causing the aerial image of the repaired mask to more closely resemble the aerial image of a non-defective mask."

A typical pattern on a mask/reticle is fabricated of chromium as chromium is suitable in blocking light in photolithography processes. The present invention uses metallic ions (e.g. gallium) to repair a defect area having an absence of material. But because the light may bend or diffract around chromium differently than the implanted metallic ions, Applicants in claim 2 implant metallic ions in the non-defective area near the defect area so that the aerial image of the repaired mask more closely resembles the aerial image of a non-defective mask. The references alone or in combination do not teach this limitation. As discussed in greater detail above and with respect to claim 1, Lowery teaches fabricating an entire mask/reticle *from scratch* (col. 4, lines 42-47) but does not contemplate the repair of a defect, and Asano only repairs defects by *removing* material. Neary does apply "anchors" that extend from his patch into clear areas around the defect to permit better blending of the patch into the mask to improve the quality of the aerial image of the repair patch (col. 4, lines 48-52), but doesn't apparently do so by the use of a beam of metallic ions. Again, Neary appears to create a patch (with or without anchors) at a different location to then

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apply to the defect, contrary to the teaching of the claim. Finally, the Examiner does not provide a rationale or reason why one of ordinary skill in the art would combine the use of metallic ions as taught in Lowery with the anchors of Neary.

None of the cited references teach scanning a beam of metallic ions over a defect area as taught by Applicants and therefore the combination of references does not teach the claimed invention. Applicants respectfully request reconsideration and allowance of this claim.

Claim 3 depends from claim 1 and is patentable for the reasons discussed above with regard to claim 1.

Claims 4-8

Among other limitations, claim 4 (and dependent claims 5-8) requires:

“repairing a defect in a photolithography mask.... comprising: scanning a beam of ions over a third area to implant atoms into the third area, the atoms altering the third area and causing an actual repaired aerial image of the first area to approximate the design aerial image more closely than did an actual unrepaired aerial image.”

As discussed above in greater detail with respect to claims 1-2, all of the references fail to teach scanning a beam of ions over a mask to repair a defect. Claims 4-8 are therefore patentable for the reasons discussed above with respect to claims 1 and 2.

Claims 9-10

Claim 9 is cancelled, its limitations included in presently amended claim 10. Among other limitations, amended claim 10 requires “in which determining an alternate structure that will

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provide an aerial image similar to the intended aerial image includes determining an alternate structure that includes an area of metallic atoms implanted by an ion beam." As discussed in greater detail above, the references fail to teach the use of metallic atoms implanted by an ion beam to correct a defect. Claim 10 is therefore patentable for the reasons discussed above with respect to claims 1 and 2.

Claims 13-15

Claim 13 states:

"A method for repairing a photolithography mask including a pattern on a substrate, the mask having a defect such that the actual pattern on the mask is different from an intended design pattern, comprising:

using a laser to remove an area of the pattern including the defect;

using one or more charged particle beams to recreate in the area a pattern that provides approximately the aerial image as the intended design pattern in the area."

The references fail to teach using a charged particle beam to repair a defect, as discussed in greater detail above in regard to claims 1 and 2. Claims 13-15 are patentable for the reasons discussed above with respect to claims 1 and 2.

Claims 19-22

The MPEP states: "If the search and examination of all the claims in an application can be made without serious burden, the examiner must examine them on the merits, even though they include claims to independent or distinct inventions." See MPEP § 803. Claims 19 and 20 were

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previously subject to a Restriction Requirement and were withdrawn from consideration in the Reply to Restriction Requirement filed on December 12, 2007, as acknowledged by the Examiner on page 2 of the Office Action. However, the Examiner has examined claims 19 and 20 on their merits in this Office Action and has therefore no serious additional burden exists. Applicants respectfully request that at least claims 21 and 22 also be examined on their merits on the grounds that they depend from claim 19 either directly or indirectly and that they are species of independent genus claim 19.

Among other limitations, claim 19 (and dependent claims 20-22) requires "supplying a quartz-producing precursor gas to the defect area; and directing an electron beam toward a defect area, the quartz-producing precursor gas decomposing in the presence of the electron to deposit quartz onto the defect area." Asano removes pattern material from a photo mask to repair opaque defects, but does not teach repairing clear defects as taught by Applicants, particularly use of a quartz-producing precursor gas. To reiterate, Asano teaches focusing an FIB to remove a portion of defect pattern film material, then uses a laser to remove the remainder of the defect material. *See abstract.*

Neary does not mention use of an electron beam at all, nor a quartz-producing precursor gas.

Neary teaches repairing a phase shift mask by ascertaining its aerial image, analyzing its aerial image and applying a patch of material accordingly. *See abstract.*

Lowery also does not teach use of a quartz-producing precursor gas to repair a mask, but fabricates a mask from scratch by ion implantation alone, particularly by "forming a pattern of ion implant areas on a transparent quartz substrate in order to change the absorption characteristics of the quartz substrate to form opaque or light blocking areas." Col. 4, lines 43-48.

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Clearly, one of ordinary skill in the art would not have found any reason to combine the references cited herein for at least the reason that neither reference contains the limitation of "supplying a quartz-producing precursor gas."

Claim 20 depends from claim 19 and includes the additional limitation "in which supplying a quartz-producing gas to the defect area includes supplying TEOS or TMCTS to the defect area." Claim 20 is patentable for at least the reasons discussed above with respect to parent claim 19, and additionally for the reason that neither reference mentions, teaches, suggests or even implies the use of TEOS or TMCTS or the properties inherent in those substances for the use of repairing a clear defect.

Claims 21-22 are patentable for the reasons discussed above with respect to parent claim 19.

Claims 5, 6, 11 and 12

Applicants note the Office Action does not specifically reject claims 5, 6, 11 and 12. Indeed, although the Summary of the Office Action indicates that claims 5, 6, 11 and 12 stand rejected, the Detailed Action omits any explanation of how any cited prior art anticipates [or renders obvious] these claims. Applicants assume the Examiner has intended those claims to be allowable if written into independent form. If this is not the Examiner's intention, applicants respectfully request that reasons for unpatentability for claims 5, 6, 11 and 12 be detailed in a following Office Action to give Applicants an opportunity to address the rejection.

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CONCLUSION

It is believed that all of the pending issues have been addressed. However, the absence of a reply to a specific objection, issue, or comment does not signify agreement with or concession of the rejection, issue, or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this reply should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this reply, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

Applicant submits that the application is now in condition for allowance and respectfully request reconsideration, withdrawal of all rejections, and allowance of the application.

Respectfully submitted,

Date:

7/25/2008

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